Use of photogrammetry for the study of riparian vegetation dynamics

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USE OF PHOTOGRAMMETRY FOR THE STUDY OF RIPARIAN VEGETATION DYNAMICS

Utilisation de la photogrammétrie pour l'étude de la végétation riveraine

Background

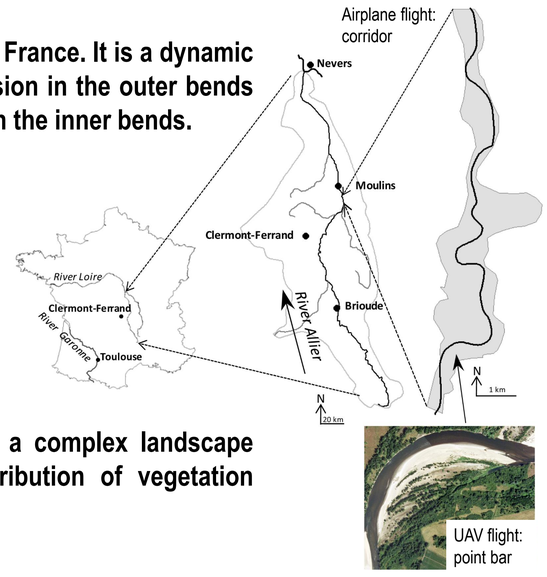
- Riparian vegetation responds to hydrogeomorphic disturbances and also controls sediment erosion and deposition. However, there are still gaps in understanding and quantifying reciprocal biogeomorphic processes within river systems. Here, we focus on the quantification of riparian vegetation dynamics. Photogrammetry can currently be used to derive two dimensional spatiotemporal variations in riparian vegetation cover within fluvial corridors as well as vegetation height models for the quantification of vegetation vertical growth rates.
- The heterogeneity of riparian vegetation height and spatial distribution including isolated trees within fluvial corridors represents a difficulty for building 3D models.

Objectives

- Building high resolution 3D photogrammetric models of riparian vegetation height based on aerial photographs at two complementary scales.
- Evaluating the quality of both models using vegetation height field measurements.

Study site

- The study reach is located on the Allier river, France. It is a dynamic wandering river characterised by lateral erosion in the outer bends of meanders and gravel point bar formation in the inner bends.

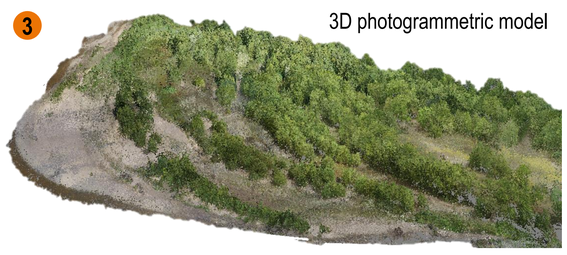


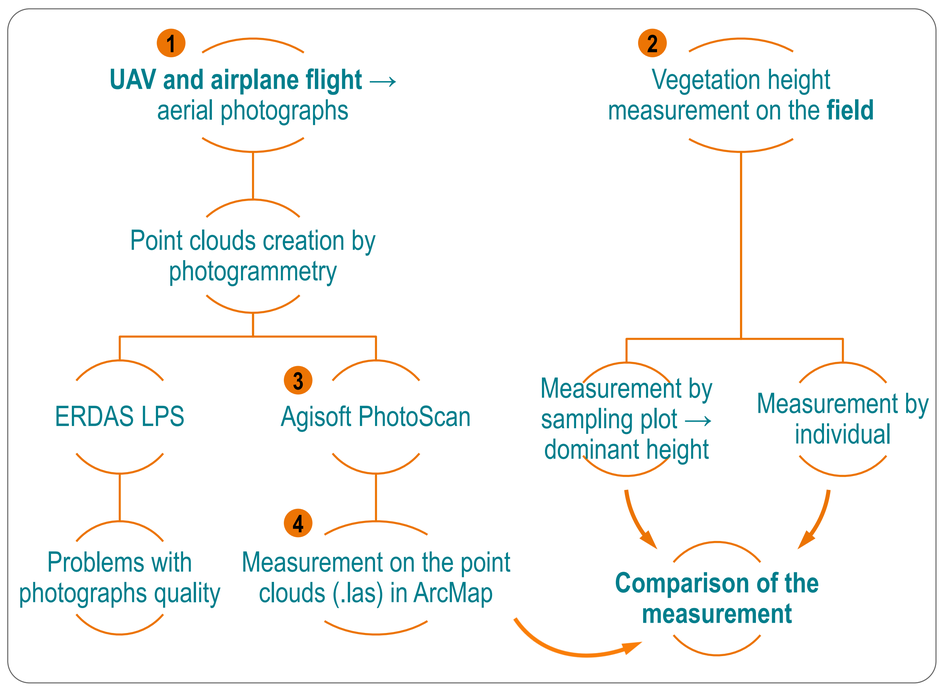
- This river section is also characterised by a complex landscape mosaic with a heterogeneous spatial distribution of vegetation patches of different sizes and ages.

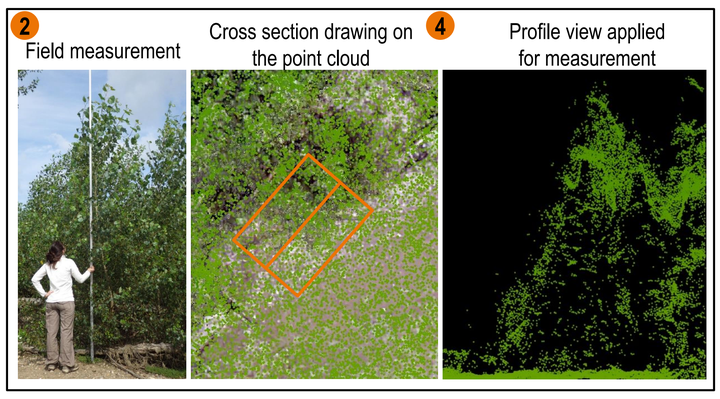
Methods

1	UAV	Airplane
Material	Falcon-8 (Asctec GmbH)	Cessna172
Scale	Point bar (18 ha)	Floodplain (2300 ha)
Camera	Sony NEX-5n	Canon EOS 6D
Flight altitude	80 m	535 m
Resolution	25 mm/pixel	10 cm/pixel

3 3D photogrammetric model







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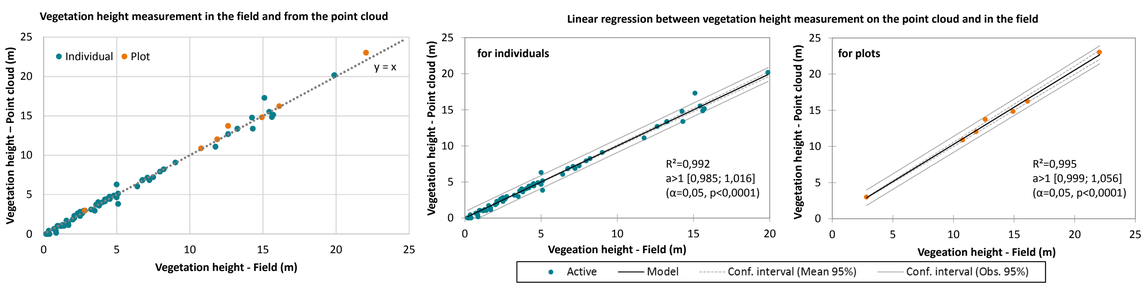
Vegetation types	Tree (poplar, salix a.), shrub, herb
Vegetation height	0,1 m – 23 m
Measurement methods	1. Isolated vegetation (individual) 2. Dominant vegetation height in circular sampling plots with a radius of 5 m
Measurement tools	5 m measuring rod, laser telemeter

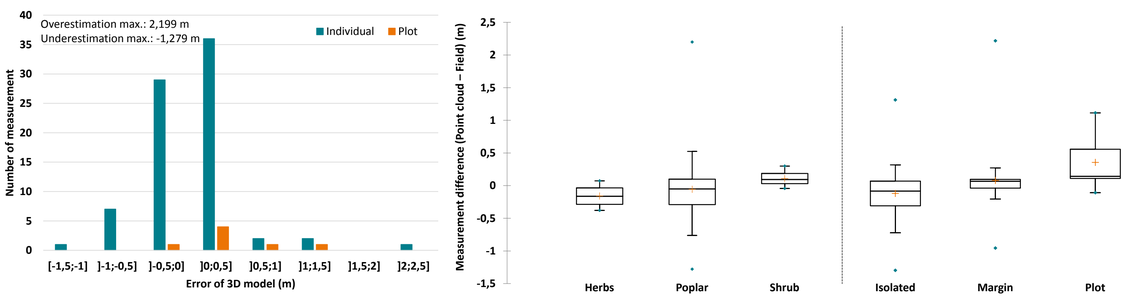
Results – evaluation of the 3D photogrammetric models of riparian vegetation height

UAV

- The model based on UAV photographs has a very good accuracy. The results show a significant overestimation for higher vegetation classes.

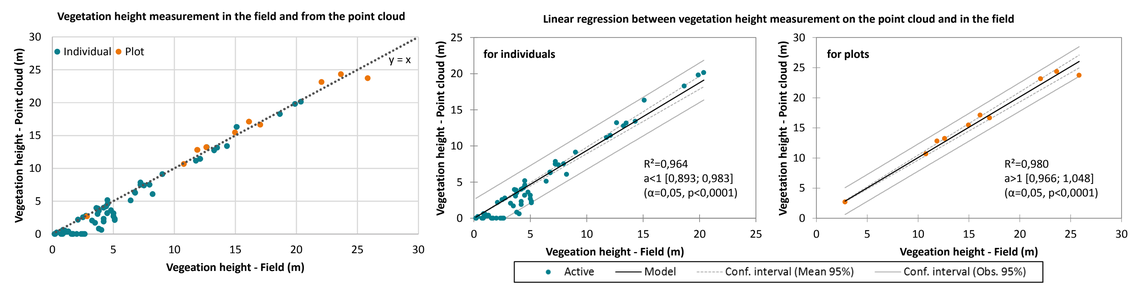


- The difference between vegetation height measured in the field and on the point cloud showed that 83,33% of the 3D model's error is between -0,5 and 0,5 m. The highest errors and variability are related to poplar trees.

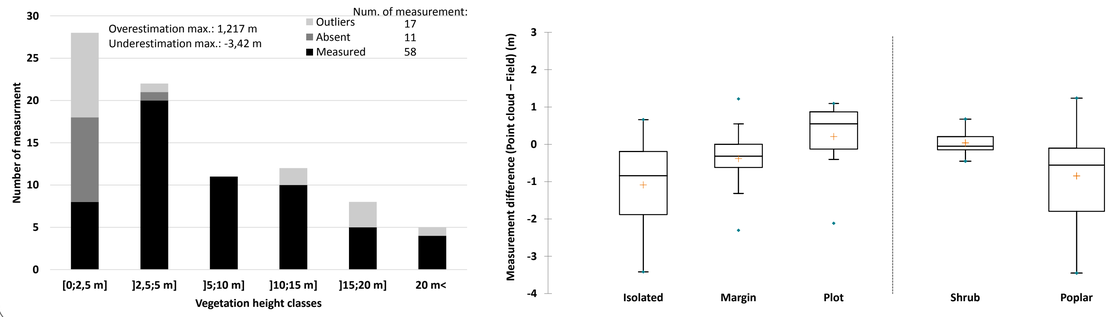


Airplane

- The model based on airplane photographs shows a lower accuracy than the model from UAV photos and a significant underestimation for isolated trees.



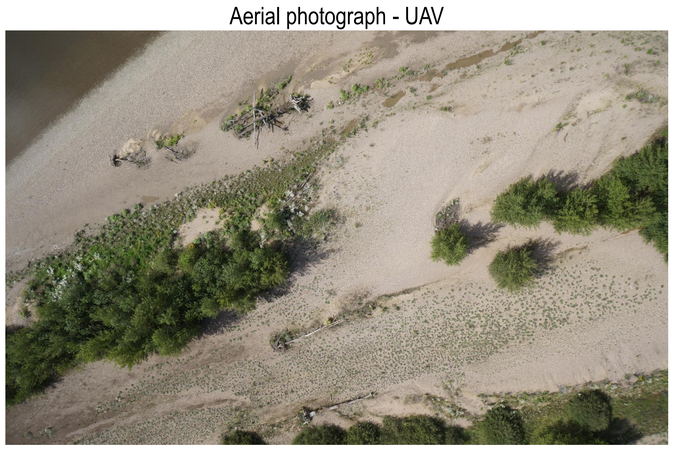
- Difficulties: 1) some of the vegetation measured in the field did not appear within the point cloud; 2) the impossibility to determine vegetation height on certain parts of the point cloud because of outliers (noise). The highest errors and variability are related to poplar trees.



Conclusions

- **UAV**
  - High precision representation of heterogeneous riparian vegetation.
  - Easier logistics and flight organisation.
  - Restrictions: 1) can be applied only on a smaller spatial scale (ex. point bar); 2) not suitable to represent small (15-40 cm), isolated poplars.
- **Airplane**
  - Medium precision representation of heterogeneous riparian vegetation.
  - Method is adequate to study riparian vegetation at a larger scale (ex. 10 km reach) and for vegetation >3 m.
  - Restrictions: 1) flight requires strict application of the flight plan; 2) logistics (target installation, availability of the pilot, the airplane etc.) and flight organization more time-consuming.
- **Peaky shape of poplar trees are more difficult to represent accurately within the point cloud.**
- **Overestimation of higher vegetation classes by the photogrammetric model compared to field measurements: related to field measurement errors?**
- **The extracted growth rates are a fundamental component to be considered when studying feedbacks between fluvial landform construction and vegetation establishment and succession.**

Aerial photograph - UAV



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